Building a Low-Carbon Society

Naoki Murakami

1. Introduction

In recent years, global warming and climate change have become critical issues worldwide. To realize a "low-carbon society" with net zero emissions of greenhouse gases, including carbon dioxide, which is responsible for these phenomena, initiatives to reduce emissions are in progress around the world. Efforts include transitioning from gasoline-fueled vehicles to electric vehicles, expanding the use of clean energy, improving energy efficiency, and reducing waste.

A low-carbon society not only contributes to mitigating global warning and climate change but also is a central theme of multiple Sustainable Development Goals (SDGs). Companies, organizations, and individuals around the world are setting their own goals as they work to achieve a low-carbon society.

We, SANYO DENKI, are also proactively developing products to contribute to achieving a low-carbon society based on our corporate philosophy of "For society and the natural environment, we will help preserve the global environment and contribute to the prosperity of mankind through our corporate activities."

This article introduces technology that reduces power consumption of cooling fans, as well as our *San Ace* products that contribute to the realization of a low-carbon society.

2. Low Power Consumption and Long Life Technologies for Achieving a Low-Carbon Society

2.1 Fans with lower power consumption and longer life for a low-carbon society

Around the world, cooling fans are installed in equipment for a wide range of applications. As such, lowering power consumption in cooling fans is an effective means of reducing fossil fuel consumption and curbing greenhouse gas emissions. Also, cooling fans with longer service life will help improve resource efficiency and reduce waste. These technologies can contribute to the SDGs shown in Figure 1.

We believe that low power consumption and long service life are important qualities of cooling fans. As such, we have developed many cooling fans with these features.

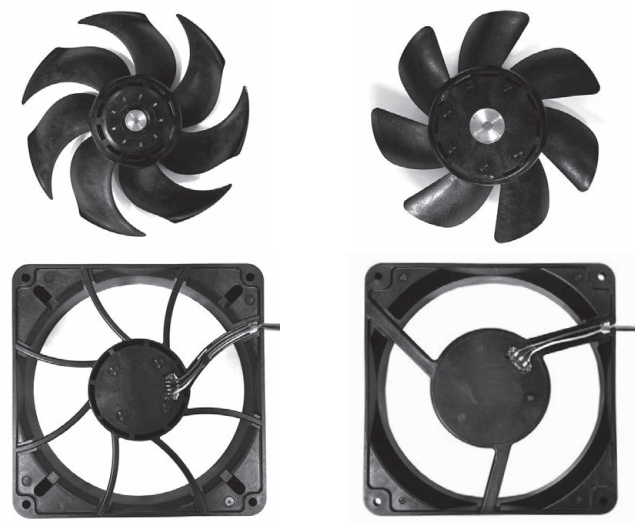
This chapter introduces some of the technologies to reduce the power consumption and extend the service life of cooling fans.

Fig. 1 The SDGs to which cooling fans with lower power consumption and longer service life can contribute

2.2 Simulation-based automated design optimization

To lower power consumption in cooling fans, it is essential for the impeller and frame to demonstrate good aerodynamic performance and for the stator core, windings, magnets, and drive circuit to provide high efficiency in motor performance. Conventionally, efficiency improvement used to be achieved through trial and error on actual equipment. In recent years, however, we have been using simulation-based design optimization to optimize efficiency. This involves importing the expertise we have accumulated over our past development efforts into simulations for automated design optimization. With this approach, we are now able to pursue even higher efficiency. Figure 2 compares the impeller and

frame shapes of our current product and our new 140 × 140 × 38 mm *San Ace 140* 9RA type, which was developed using simulation-based automated design optimization. Figure 3 compares the power consumption and noise level of them at equivalent cooling performance.



New product Current product

Fig. 2 Impeller and frame of the new *San Ace 140* 9RA type and current product

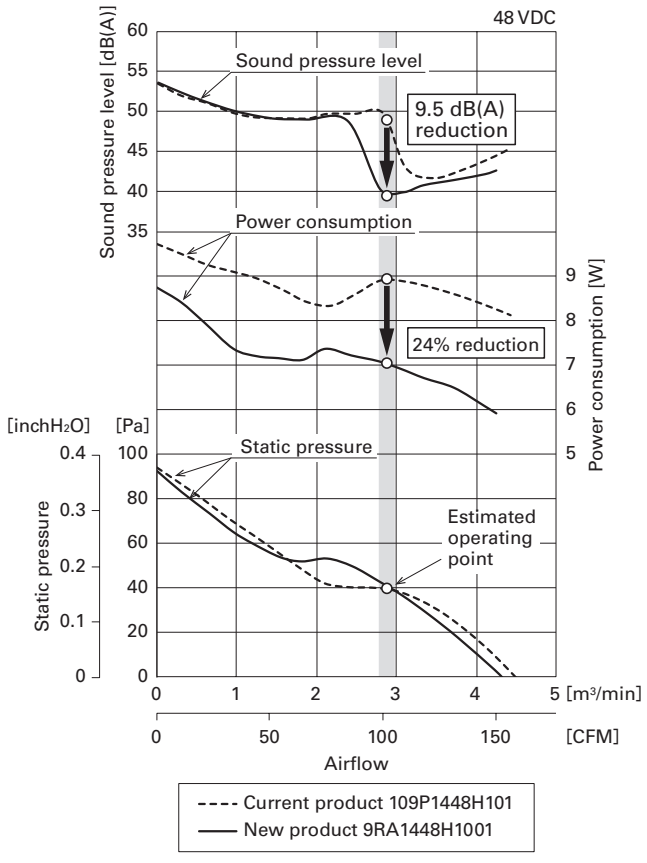
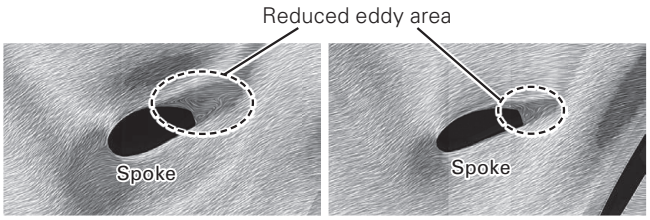


Fig. 3 Characteristics comparison between the new *San Ace 140* 9RA type and current product

The improved motor efficiency and aerodynamic performance have resulted in significantly lower power consumption and noise compared to the current product.

2.3 Visualization of airflow

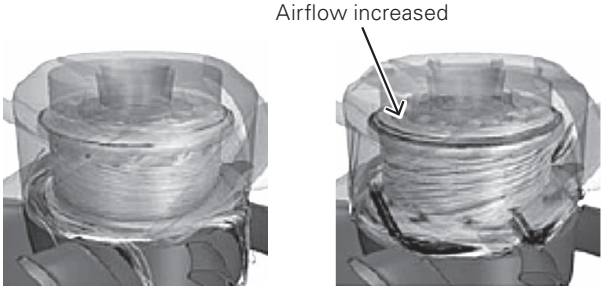
To refine the details of the impeller and frame shapes generated by the aforementioned automated optimization process, we have been using simulations to visualize airflow. Unsuitable impeller and frame shapes can cause significant turbulence and eddies around the impeller blades and frame spokes, leading to reduced efficiency and elevated noise levels. Simulation-based visualization of airflow enabled us to assess the extent of turbulence and eddies, providing insight into how changes in the impeller and frame shapes lead to improvements. Figure 4 shows an improvement in eddy reduction through the modification of the frame spoke's shape.



Before improvement After improvement

Fig. 4 Eddy suppression through redesigned spoke shape

We also use simulation-based visualization of airflow to achieve longer service life. To extend service life, it is effective to use a self-cooling structure that keeps the temperature of the motor and bearing low. The use of simulations to visualize the internal airflow has enabled us to design a structure with an improved self-cooling capability. Figure 5 shows the visualization of internal airflow. Compared to Structure A, Structure B has an increased internal airflow, indicating a better self-cooling capability.



Structure A Structure B

Fig. 5 Visualization of internal airflow

Simulation-based automated design and the visualization of airflow have clarified how the input (parameters and shapes) affects the output (efficiency and power consumption). As a result, we can now design impellers, frames, motors, and structures to make cooling fans that consume less power and last longer.

We will continue to improve our simulation technology and its precision to develop fans with even higher performance.

3. *San Ace* Fans Contributing to Achieving a Low-Carbon Society

Our *San Ace* lineup includes Low Power Consumption Fans, Long Life Fans, and many other products that contribute to a low-carbon society. This chapter introduces examples of these products and their features.

3.1 The *San Ace* 9RA type with low power consumption and low noise

The *San Ace* 9RA type, characterized by its low power consumption and low noise, has been developed as a replacement for our current products: the *San Ace* 9P, *San Ace* 9R, and *San Ace* 9G types. With sizes ranging from 60 × 60 mm to 140 × 140 mm, the new product consumes less power and produces less noise than the current products while maintaining the same size and cooling performance.

Thanks to its significantly reduced power consumption, the 140 × 140 × 38 mm *San Ace 140* 9RA type mentioned in section 2.2 produces 41% less CO_2 emissions over its product life cycle compared to the current product (according to our LCA calculation software).

3.2 The *San Ace* 9LG type High Airflow Long Life Fan and the *San Ace* 9WL type High Airflow Long Life Splash Proof Fan

Our lineup offers new fans that boast higher airflow and long service life: the *San Ace* 9LG type, and the *San Ace* 9WL type with water and dust protection. These cooling fans are ideal for cooling equipment in the renewable energy and EV markets, which require both long service life and water and dust protection.

Tables 1 and 2 compare the expected life and general specifications of the 140 × 140 × 51 mm *San Ace 140L* 9LG type and the *San Ace 140W* 9WL type with our current products, respectively. The *San Ace* 9LG and *San Ace* 9WL types have 1.1 times the maximum airflow and 2.7 times the maximum static pressure of the current products. Moreover, the expected life at an ambient temperature of 60°C is three times longer for the *San Ace* 9LG type and 1.7 times longer for the *San Ace* 9WL type (survival rate of 90%, run continuously at rated voltage and normal humidity in free air).

Table 1 Comparison of the new *San Ace 140L* 9LG type and current product

Model no.	Expected life [h]	Max. airflow [m^3/min]	Max. static pressure [Pa]
New product 9LG1412P5G001	180,000	9.0	655
Current product 9LB1412S501	60,000	8.1	240

Table 2 Comparison of the new *San Ace 140W* 9WL type and current product

Model no.	Expected life [h]	Max. airflow [m^3/min]	Max. static pressure [Pa]
New product 9WL1412P5G001	100,000	9.0	655
Current product 9WB1412S501	60,000	8.1	240

3.3 The *San Ace* 9AD type ACDC Fan and the *San Ace* 9ADW type Splash Proof ACDC Fan

The *San Ace* 9AD type ACDC Fan incorporates a DC-powered motor with low power consumption while operating on AC power, achieving lower power consumption and an extended service life compared to our current AC fan of the equivalent size. It comes with PWM control, a feature not available in AC fans, enabling fan speed control based on the operating conditions for further reduction in power consumption. We also offer the *San Ace* 9ADW type Splash Proof ACDC Fan serving as an effective energy-saving solution for various devices requiring AC power input.

Figure 6 compares the power consumption of the ø172 × 150 × 51 mm *San Ace 172AD* 9AD type and 9ADW type with our current product at equivalent cooling performance. It shows that the new product consumes 48% less power than the current product when the fan speed of the new product is reduced by PWM control to match the cooling performance of the current product (60 Hz). The *San Ace 172AD* has an expected life of 40,000 hours at 60°C (survival rate of 90%, run continuously at rated voltage and normal humidity in free air), which is 1.6 times longer than the current product's expected life of 25,000 hours.

In June 2023, we launched the 120 × 120 × 25 mm *San Ace 120AD* ACDC Fan, the slimmest of our ACDC fans. Details are covered in a separate article in this Technical Report.

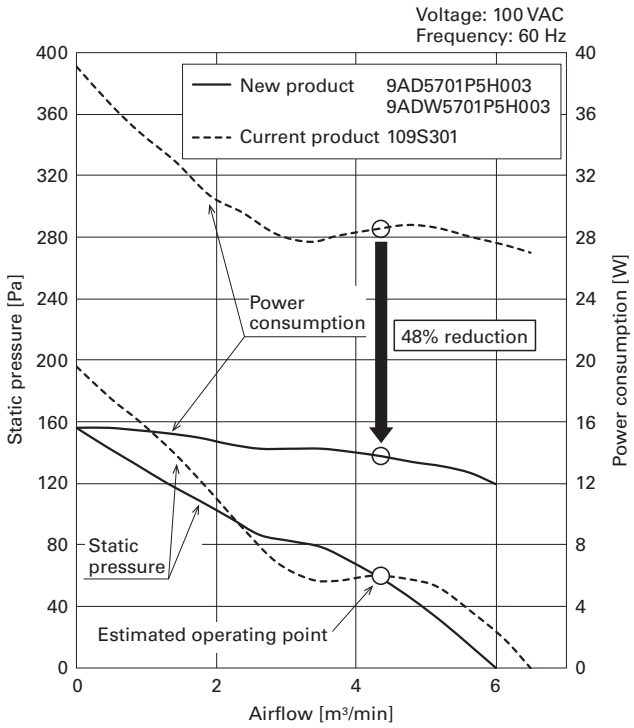


Fig. 6 Comparison of the new *San Ace 172AD* 9AD/9ADW types and current products

3.4 Fan controller

Our lineup also includes the *San Ace Controller,* an IoT-ready fan controller. Figure 7 shows an example system configuration for the *San Ace Controller.* The *San Ace Controller* allows PWM fan speed to be optimized, reducing excessive power consumption. Combined with a dedicated sensor, it can provide automatic control of cooling fans. For instance, with a temperature sensor, it enables the monitoring of the temperature inside equipment and automatically controls fan speed based on the measurement. This contributes to maintaining optimal fan speed, leading to a reduction in power consumption.

In addition, as the San Ace Controller can remotely monitor the fan speed and current of the cooling fans, alarms can be issued when necessary. These functions help users estimate the service life of a cooling fan in its actual operating environment and perform maintenance at optimal intervals.

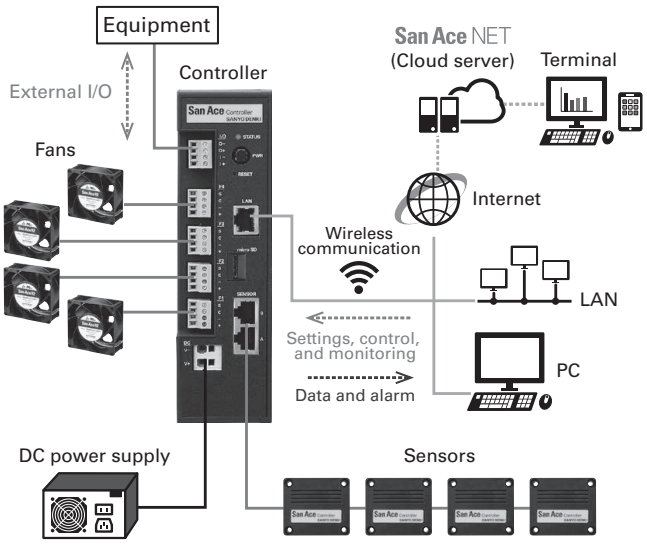


Fig. 7 *San Ace Controller* system configuration

4. Conclusion

This article has introduced technologies to lower power consumption and extend the service life of cooling fans, as well as our *San Ace* products that contribute to the realization of a low-carbon society.

Achieving a low-carbon society is crucial not only for meeting the SDGs, curbing global warming, and addressing climate change but also a global imperative. Accordingly, companies, organizations, and individuals around the world are setting their own goals to tackle this global challenge. In addition to our commitment to achieving our environmental impact reduction targets, we, as a global manufacturer with worldwide product reach, will continue to contribute to achieving a low-carbon society by developing and providing products designed for this overarching goal.

Reference

(1) Masahiro Koike and 4 others: "High Airflow Long Life Fan / High Airflow Long Life Splash Proof Fan *San Ace 140L* and *San Ace 140W*"
SANYO DENKI Technical Report No. 46, pp. 7-12 (2018.11)

(2) Naoya Ozumi and 4 others: "⌀172 × 150 × 51 mm *San Ace 172AD* 9AD Type ACDC Fan and *San Ace 172AD* 9ADW Type Splash Proof ACDC Fan"
SANYO DENKI Technical Report No. 46, pp. 9-13 (2021.11)

(3) Satoshi Tateyama and 5 others: "140 × 140 × 38 mm *San Ace 140* 9RA type"
SANYO DENKI Technical Report No.55, pp. 9-13 (2023.5)

Author

Naoki Murakami
Design Dept., Cooling Systems Div.
Works on the development and design of cooling fans.